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(54) AN IMPROVED KNITTED ELASTIC BANDAGE

(71) We, THE KENDALL COMPANY, of 95 West Street, Walpole, Massachusetts, United States of America, a corporation organised and existing under the laws of the State of Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

Elastic bandages are normally woven on a narrow loom, the retractive and supportive power being supplied by special warp yarns.

In the early days these were overtwisted cotton warp yarns, but use of cotton warp yarns has been displaced to a considerable extent by the use of elastomeric warp yarns, initially of extruded or cut rubber and more recently of elastomeric man-made polymers. Such elastomeric warp yarns are usually wrapped with a layer of non-elastomeric filaments.

Such bandages, although effective in use, suffer from the disadvantage of being relatively expensive. They are produced singly on a narrow loom, utilizing expensive wrapped elastomeric yarns, at comparatively slow production rates inherent in the weaving process.

In an attempt to circumvent the limitations of woven bandages, it has been proposed to produce warp knitted elastic bandages, containing elastomeric warp yarns and very heavy filling yarns to prevent necking-in of the bandage when stretched. Such bandages are relatively heavy, averaging 6 to 12 oz. per square yard, and due to their compact structure they become hot and uncomfortable to wear. Also, when applied to a limb or other part of the body they must be secured in place in the outer wrap by fastenings, such as toothed metal clips. As the bandage is worn, the layers of the bandage tend to slip and slide past each other, leading to the undesirable alternatives of frequent removal and rewinding or else winding the bandage with an uncomfortable degree of tension.

The invention is based on the discovery that, by using false-twist filament yarns in the warp with non-elastic filling yarns inlaid in the warp yarns as described below, a new type of elastic bandage can be produced which has stretch and power characteristics comparable with those of conventional elastic bandages of woven structure.

By "false-twist filament yarn" is meant a texturized continuous filament yarn which has been given increased bulk and loft, togeter with stretch, by the introduction into the yarn of crimps, loops, coils, and crinkles by false-twisting. Such yarns are commercially produced by well-known processes, and when the filamentary material is thermoplastic, as is the case with nylon, a heat-setting stage in the false-twist process renders the stretch and the crimped configuration of the yarn relatively permanent.

Depending on the direction of rotation of the spindle, the yarn may be twisted clockwise or counterclockwise, giving rise to S-twist or Z-twist in the yarn. It is customary to employ both types of twist where it is desired to minimize torque and twist in a fabric, either as alternate warp yarns or as a yarn of one twist plied with a yarn of opposite twist.

The invention accordingly provides an open mesh knitted elastic bandage, overlapped layers of which are capable of clinging to each other, the bandage comprising a set of composite parallel warp yarns, which extend lengthwise of the bandage and each of which comprises a first false-twist filament yarn formed into a stitch chain with a second falst-twist filament yarn of opposite twist inlaid into the loops of said first false-twist filament yarn, and a set of non-elastic filling yarns deployed across one

surface of the bandage and inlaid in the warp yarns in a pattern repeated across the width of the bandage, the filling yarns in each pattern repeat forming pattern sections, repeated lengthwise of the pattern repeat, and each of which consists of two overlapping pairs of filling yarns which extend in slack serpentine configuration across the repeat starting from the warp yarns bounding opposite sides of the repeat, the filling yarns in one of the pairs proceeding in diagonal fashion across the repeat from one side to the other and back again and the filling yarns in the other pair proceeding part way only across the repeat in a direction transverse to the warp yarns but sufficiently to overlap one another.

It is a characteristic of the bandage according to the invention that, in order to minimise the tendency of the knitted fabric to narrow in when stretched, the chain-stitched warps are not knitted together, but are held together by interlocking filling yarns of conventional non-elastic type, inlaid in the particular pattern referred to above and described more fully below.

The invention will now be described in more detail with reference to the accompanying drawings, in which:-

Figure 1 is a magnified view of a segment of a bandage according to the invention in the relaxed state;

Figure 2 is a similar view of a portion of the bandage under 50% extension;

Figure 3 is a highly magnified view of a false-twist yarn used in the bandage;

Figure 4 is a diagram showing the interrelationship of the warp and filling yarns;

Figures 5, 6, 7 and *8* represent the paths of the individual filling yarns in a preferred embodiment of the invention; and

Figure 9 is a composite of Figures 5, 6, 7 and 8.

For the sake of clarity, the involved nature of the false-twist warp yarns if shown only in Figure 3.

The bandage shown in Figure 1 comprises a set of false-twist filament warp yarns 10, which extend in the lengthwise direction of a bandage and are interconnected by non-elastic filling yarns 12 which are interlocked with at least a majority of the chain loops of the warp yarns. The bandage is of open, porous construction, the air porosity of which is usually in excess of 500 cubic feet of air per square foot at 0.5 inches of air pressure, as tested on the Frazier air permeability device. This porosity is in part due to the light weight of the bandages of this invention, which customarily lies in the range of 2 to 3 oz. per square yard, whereas conventional elastic bandages weigh 6 to 12 oz. per square yard.

When the bandage is lightweight and of very open mesh, the tendency of false-twist inlay yarns of a given type of twist, S or Z, to impart curl to the bandage is minimized, because the inlay yarns are combined with chain stitch yarns of opposite twist. For simplicity in manufacture, it is desirable to utilise warp yarns which are all of the same composite nature, each composite yarn consisting either of a chain stitch S yarn with a Z twist inlay, or a Z twist yarn with an S twist inlay. If the bandage is made of a tighter mesh, so that it tends to curl, especially when wet, the warp yarns may be arranged as shown schematically in Figure 4, wherein the fuzzy kinked nature of the false-twisted yarns comprising the warps has been omitted for the sake of clarity. In this specific instance, each warp 10 consists of a falst-twist Z yarn 10A and a counterbalancing false-twist S yarn 10B, and the composite warp yarns are made up, in alternating fashion, of a chain-stitched Z twist yarn with an S yarn inlaid in the loops of the chain, and a chain-stitched S yarn with a Z twist yarn inlaid in the loops of the chain.

The filling yarns do not extend parallel to one another across the width of the bandage as suggested in Figure 4 but are deployed across one surface of the bandage, as shown in Figures 1 and 2, and inlaid in the warp yarns in a pattern repeated across the width of the bandage. A portion of the complete pattern repeat situated at one edge of the bandage is shown at the top of each of Figures 1 and 2. In each pattern repeat, the filling yarns consist of an overlapping pair which extend diagonally across the repeat starting from the warp yarns bounding the repeat at opposite sides as shown in Figures 5 and 8 and another overlapping pair which, again starting from the warp yarns at opposite sides of the repeat, are disposed in staggered fashion across a varying number of the warp yarns as shown in Figures 6 and 7. The four filling yarns in a section of a pattern repeat overlap one another and are interlocked with the warp yarns as shown in Figure 9, and the overlapping pattern of the weft yarns shown in Figure 9 is repeated over the length of the pattern repeat.

As shown in Figure 1, the filling yarns 12 lie slack, in cursive or looped configuration on the surface of the bandage. This relaxed condition of the filling yarns is important because it allows the elasticity of the false-twist yarns 10 to be utilized without any substantial necking-in or width wise contraction when the bandage is stretched. It is due in part to a heat-shrinkage process to which the bandage is subjected after it comes from the warp-knitter. Probably in greater part, however, the relaxed condition of the filling yarns is due to the unusual manner in which the lightweight filling yarns are deployed through the warp yarns, as described above and as shown schematically in Figures 5, 6,

7, 8 and 9. This arrangement of the filling yarns has been found to impart an unexpected degree of stability to the bandage when it is extended.

Example

A bandage was constructed on a crocheting machine, utilizing five yarn guide bars per repeat operating in a vertical plane perpendicular to the horizontal needles of the machine, four of the bars moving across the width of the fabric to insert into the loops of the warp yarns filling yarns of 30/1 spun rayon (i.e. single ply rayon of yarn size 30, weighing 30 hanks to the pound), and the fifth bar being utilized to insert the inlaid false twist yarn 10A or 10B. The filling yarn pattern was that shown in Figures 5, 6, 7 and 8, each of the guide bars operating independently. The false-twist yarns 10A and 10B were 70/1/17 Z twist and 70/1/17 S twist Superloft nylon, Superloft being a trade name for false-twist yarns made on a Leesona (Registered Trade Mark) false-twist apparatus. These nylon yarns were single ply 70 denier yarns consisting of 17 individual filaments. There were nine warp yarns in each repeat, a total of 57 needles being used in the production of a bandage four inches wide with 14 composite warp yarns per inch. The filling yarns were inserted at the rate of 17 picks per inch.

The rayon filling yarns were inlaid into the loop-forming chain stitch false twist warp yarns in the manner shown in Figures 5, 6, 7 and 8, which illustrate the particular patterns in which each of the four filling yarns is deployed to form the composite filling yarn structure shown in Figure 9.

The bandage as formed on the machine weighed about 60 grams per square yard. It was then conditioned by exposing it, untensioned, to moist steam at about 140°F for one to two hours, after which it was dried. During this steaming process the bandages underwent shrinkage, increasing in weight to about 70 grams per square yard. In addition, the filling yarns became relaxed from their off-machine regular configuration to the cursive configuration shown in Figure 1. This relaxation builds slack into the filling yarns, and in part accounts for the ability of the bandage to be stretched without an accompanying decrease in width.

The finished bandage weighed 70 grams per square yard and had an air porosity of over 900 cubic feet of air per square foot per minute at 0.5 inches pressure, as tested on the Frazier air permeability apparatus.

At 100% elongation the bandage had 9 filling yarns per inch, with 14 composite warp yarns per inch. Since the filling yarns were 30/1, the filling cover factor was about 2, an extremely low factor characteristic of open-mesh netting. Cover factor is a measure of the degree of openness of a fabric, and is calculated as the number of yarns per inch divided by the square root of the yarn count in the cotton system. In the bandages according to the invention, the number of filling yarns per inch of bandage under 100% extension preferably lies within the range of 8 to 20, with the filling yarns ranging from 20's to 60's in count, so that the cover factor is less than 5.

This low cover factor in the filling brings the crimped, curled, and looped nature of the warp yarns into prominence as a dominant surface characteristic of the bandage. When the bandage is applied to a limb by overlapping, each layer of the bandage clings firmly to each adjacent layer with which it is in contact, due to the interlocking of the crimps and curls of the warp yarns in one layer with the warps in adjacent layers. The bandage therefore resists slipping and displacement when the limb is flexed during movment, an advantage not present in conventional elastic bandages.

Bandages according to the invention can be stretched to substantially the same extent as conventional elastic bandages, a representative range being 60% stretch under a force of 10 pounds up to 170% stretch under a force of 50 pounds. In addition to being lightweight and comfortable to wear, due to their porosity, they are absorbent, and are easy to wash and sterilize. Since they contain no rubber or synthetic elastomeric material, they may be used in cases where elastomeric yarns in contact with the skin give rise to an allergenic reaction.

It will be appreciated that, unlike the production of woven bandages on a narrow loom, the knitted bandages according to the invention may be produced on a wide flatbed machine, and that a plurality of bandages, of varying widths if desired, may be produced in a single machine operation using a tie-in yarn between individual bandages, said yarn being readily removed subsequently by an unraveling operation.

WHAT WE CLAIM IS:-

1. An open mesh warp knitted elastic bandage, overlapped layers of which are capable of clinging to each other, the bandages comprising a set of composite parallel warp yarns, which extend lengthwise of the bandage and each of which comprises a first false-twist filament yarn formed into a stich chain with a second false-twist filament yarn of opposite twist inlaid into the loops of said first false-twist filament yarn, and a set of non-elastic filling yarns deployed across one surface of the bandage and inlaid in the warp yarns in a pattern repeated across the width of the bandage, the filling yarns in each pattern repeat forming pattern sections, repeated

lengthwise of the pattern repeat, and each of which consists of two overlapping pairs of filling yarns which extend in slack serpentine configuration across the repeat starting from the warp yarns bonding opposite sides of the repeat, the filling yarns in one of the pairs proceeding in diagonal fashion across the repeat from one side to the other and back again and the filling yarns in the other pair proceeding part way only across the repeat in a direction transverse to the warp yarns but sufficiently to overlap one another.

2. A bandage according to claim 1, in which the filling yarn cover factor is less than 5 when the bandage is under 100% extension.

3. A bandage according to claim 1 or claim 2, in which the warp yarns are of heat-set thermoplastic material.

4. A bandage according to any one of the preceding claims, in which the warp yarns consist alternately of chain-stitch false-twist S yarns with a false-twist Z yarn inlay and chain-stitch false-twist Z yarns with a false-twist S yarn inlay.

5. A bandage according to claim 1, substantially as described herein with reference to the accompanying drawings.

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1581295 COMPLETE SPECIFICATION
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Sheet 1

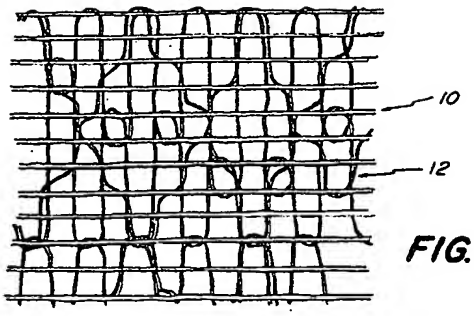

FIG. 1

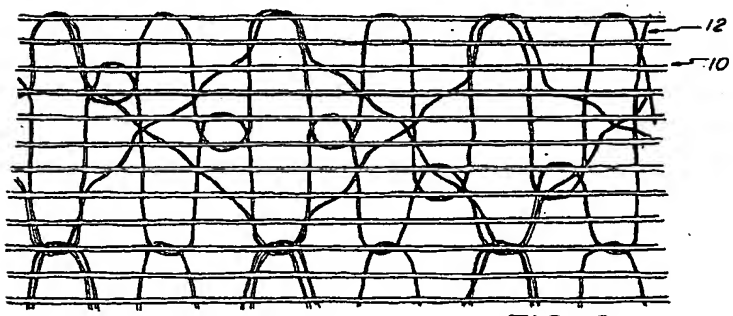

FIG. 2

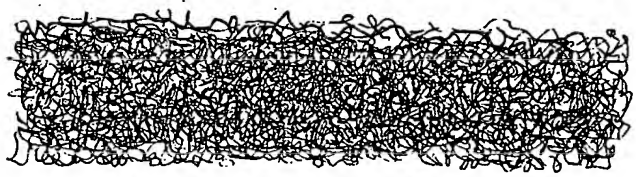

FIG. 3

1581295 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

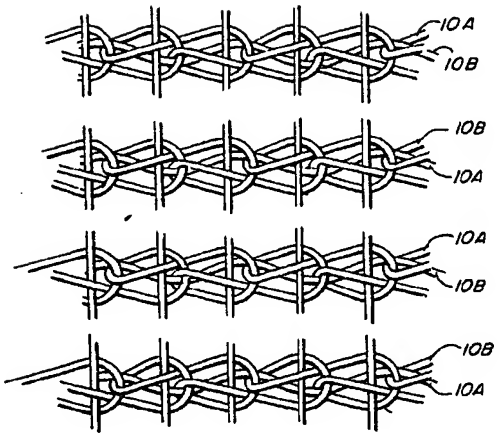

FIG. 4

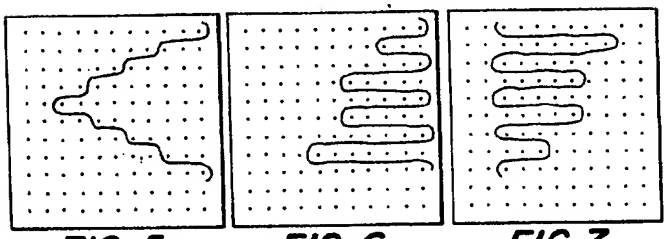

FIG. 5 FIG. 6 FIG. 7

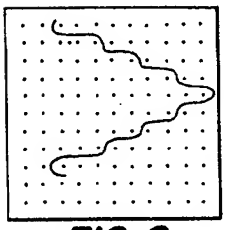

FIG. 8

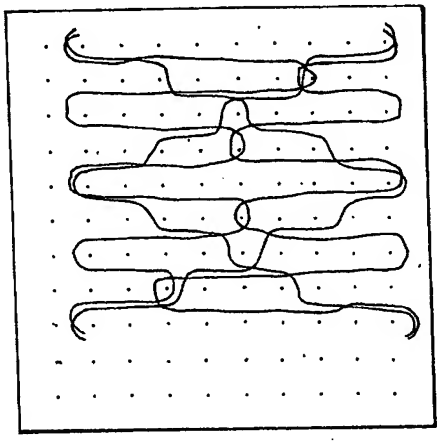

FIG. 9